Coconut based integrated farming for multiple benefits

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Traditional coconut farming, in general, lacks in species multiplicity and functional diversity. Perhaps, the situation in home gardens is similar to that of natural ecosystem but, even here, the replenishment of soil organic matter through organic recycling does not take place at optimum levels. The major reason is that both in home gardens and in larger farming units no part of the coconut biomass becomes available to the soil. Along with coconut, the other components of the biomass such as fronds, stipules, bunch stalk, husk, shell etc. constitute sources of income to farmers and, as such, do not form part of the recyclable wastes in the soil. Coconut gardens in most of the states in India are clean tilled on a regular basis which encourages rapid decomposition of the added and native organic matter leading to impoverishment of the soil.

Among the coconut growing states in India, Kerala is credited with having the longest history of coconut cultivation. Coconut culture in the state has continued since pre-historic times without the benefit of proper cultural management. The land under coconut has undergone a process of degradation as a result of organic matter depletion, inactive soil life and faulty cultural practices leading to soil erosion and water run-off. Perhaps, the impaired soil health and the depleted soil life could be the major contributory factors for the widespread prevalence and virulence of many diseases of coconut palm such as the debilitating root wilt disease, leaf rot disease etc.

Coconut Based Integrated Farming for Ecological Benefits

Integrated farming is a land management system involving a combination of diverse but compatible groups of trees, shrubs, herbaceous plants and livestock including poultry in the same operational holding. The system promotes functional diversity and maximum positive interaction between components. In the traditional coconut farming, farmers cultivate miscellaneous food crops in the interspaces. When tree species of complementary nature are also introduced, either along the border or in the centre of the palm rows, a system resembling natural ecosystem is created. The tree species close their canopy within a few years and along with the coconut palms and the herbaceous plants available underneath present a multilayered canopy structure which offers protection to soil from extremes of temperature, surface runoff and erosion. The woody components in the system also produce a surface litter layer which is replenished by leaf fall. The litter layer has a profound influence on the physical, chemical and biological properties of the soil. The continuous availability of shed leaves and other organic refuses on the soil surface promotes sustained biological transformations in the soil leading to improvement in soil structure, better availability of plant nutrients and enhanced soil life.

Tree species under coconut

Livestock is a very important component in the integrated farming system. Cattle and poultry contribute to efficient recycling of organic wastes available in the system. When animals are fed fodder collected from outside sources, there is a nutrient flow from different locations to the farm. In a properly organized farming system with livestock as an essential component, there is maximum utilization of organic wastes and their efficient conversion into valuable manure.

In the integrated farming system, the trees and shrubs facilitate nutrient cycling. The nutrients available in the deeper layers of the soil are extracted and transported to the soil surface with leaf litter. In the presence of an abundant supply of fresh organic refuses on the soil surface, the natural diversity of the soil life is stimulated. The population of earthworms multiplies and their enhanced activities improve both the physical and chemical properties of the soil. There is also a closer interdependence between

Vegetables and backyard poultry

Banana and tuber crops under coconut

the roots of higher plants and soil organisms. The continuous availability of root sloughs and exudates sustain an active and diverse soil life in the rhizosphere. When the soil life is enhanced, the disease causing organisms are usually outnumbered by their antagonists making natural control of soil borne pathogens possible.

When nitrogen fixing trees are included in the system, the associated crops are benefited from the nitrogen fixed in nodules on the roots of leguminous as well as some non-leguminous trees. Mycorrhizal fungi are commonly found associated with the roots of nitrogen fixing trees. Mycorrhizal infections increase the mobility of phosphates and other poorly mobile ions such as potash, magnesium, zinc and copper. These nutrients which would have been lost in leaching are retrieved by the tree roots and deposited on the soil surface in the form of leaf litter.

The presence of diverse tree species in the coconut holdings has a salutary effect on the water economy. By acting as wind break and by causing partial shade in the inter spaces of palm rows, the trees reduce evaporation loss of water. They also offer a barrier effect on the surface flow of water during rainy season and thereby facilitate better infiltration. The tree components of the system minimize the hazards of soil and water erosion, stimulate the underlying productive capacity of the soil resource, improve the quality of local environment and strengthen biological diversity. The tree components also function as effective sink for carbon dioxide and many air pollutants, both gases and particulates.

Coconut Based Integrated Farming for Socio-Economic Benefits

Apart from the protective or ecological advantages of integrated farming, the system benefits the farming community in different ways. With the introduction of a variety of crops, farm animals and other enterprises in the system the net returns from unit area, time and inputs increase considerably besides freeing coconut farmers from the risks involved in the cultivation of monocrop. The integrated farms permit the repeated use of organic wastes and by-products and, thereby, help to increase the per capita energy consumption. The system facilitates the production of multiple products and also improves the productivity of coconut palm by stimulating positive interaction between different components. The generation of additional employment opportunities is another advantage. In a state like Kerala where the root wilt disease is rampant in many districts, coconut-based agroecosystem will have positive influence on the health of both the soil and the palm which is likely to stimulate the natural resistance of the palm against disease causing pathogens and/or soil borne pathogens.

Cultural Management in Coconut Based Integrated Farming

In most of the States in India coconut land is clean tilled and kept free of weeds. It is practiced in all soil types adopting different tillage practices. In this process weed growth is completely eliminated and a surface layer of soil mulch is maintained to break the upward capillary movement of soil moisture. In a coconut based integrated farming system it is not a desirable practice to clean till the soil. The maintenance of surface litter as well as weed growth is useful in ameliorating the soil conditions as well as the agroclimate of the holding. Frequent tillage causes mechanical injury to the earthworm population of the soil besides resulting in the removal of all surface vegetation leading to

temperature rise, evaporation loss of soil moisture and depletion of soil organic matter. Surface vegetation, whether it is a pasture, fodder grass or even ordinary weed growth, will contribute to a regular addition of carbonaceous matter to the soil in the forms of sloughs and root exudates for the soil organisms including earthworms to act upon.

For the maintenance of soil fertility in a coconut based integrated farming system weeds are not to be eliminated but only suppressed for deriving maximum agronomic benefits. Normally, weed growth is suppressed under the leaf litter available in an integrated farming system. When the weeds overgrow slash weeding and using the biomass as mulch is the most desirable practice. It is, however, essential to keep the effective root zone of the palm, which lies within a radius of 2 m from the bole, free of weed growth. Mulching the root zone with any locally available organic material effectively checks weed growth. Such cultural practices in coconut holdings would facilitate a natural process of dissolution and synthesis in the soil.

Perhaps, minimum tillage will be required in soils which form hard surface crust on drying. Under such situations tillage breaks the crust, prevents surface flow and facilitates water infiltration. In all other soil types tillage could be dispensed with and the soil left undisturbed. When surface cover of leaf litter and slashed weed growth is maintained along with good organic mulch in the tree basins, the water holding capacity of the soil is improved and surface evaporation is minimized. Consequent to these improvements, it is possible to economize on the use of irrigation water. It has been observed that even in sub-humid and semi-arid regions in India where coconut is grown, the adoption of minimum or no tillage along with the use of organic mulch in the palm basins has resulted in a saving of irrigation water by 50% without any reduction on the level of productivity especially when drip irrigation is practiced.

While the coconut based integrated farming system presents both economic and ecological advantages, it has to be adjusted to the local agroclimatic situation for deriving positive results. In a coconut garden, the growing of other tree species is less likely to offer canopy competition when the palm crown constitutes the upper storey. However, root competition for nutrients and moisture cannot be ruled out in the system. In humid areas where rainfall is plenty and the tree litter are not removed but applied to the soil as mulch or fed to cattle and recycled, root competition could be avoided provided the tree species are planted at least 2 m away from the bole of the palm. However, the situation is different in low rainfall areas where root competition will operate. But in low rainfall belts, coconut palm is generally cultivated as an irrigated crop and when irrigation is adequate, the possible adverse effects of root competition for moisture could be kept to a minimum. Here also the systematic use of tree litter in the garden is essential.

R&D Support for Promoting Coconut Based Integrated Farming

Studies have to be organized in Research Stations to understand the techno-economic aspects of integrated farming in coconut holdings in relation to holding size, agroclimate and local needs. The most appropriate tree species and the optimum tree population in coconut holding have to be determined for different climatic zones. The studies shall also cover the cultural requirements in the system and whether sustainable production at higher levels would need supplementary use of fertilizer inputs. The role of nitrogen fixing tree species in the system and the management needs for deriving maximum benefit from such trees have also to be studied.

A major development project for promoting integrated farming in coconut holdings shall be formulated and implemented with the objectives of (1) facilitating the conversion of monocropped coconut holdings into ecologically and economically stable agro-ecosystems through the introduction of integrated agriculture in which organic recycling or the repeated use of farm wastes is an essential constituent and is also the linking or binding force between each and every practice, (2) identifying the basic needs in each holding and extending techno-economic support for the selection, procurement and management of the essential components of the system covering multispecies cropping, cattle/goat/ piggery/poultry/ rabbit rearing, bee keeping, pisciculture etc. and for the integration of biogas production unit, and (3) organizing workshops, trainings etc. for the benefit of the participating farmers as well as the field extension personnel.

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